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Canadian Forestry Service-Maritimes

TECHNICAL NOTE

WINDBREAKS FOR OVERWINTERING PLANTING STOCK

Many Maritime nurseries are now overwintering container seedlings for planting the following spring. Outside storage of large numbers of seedlings, where there is no environmental control, has resulted in cultural difficulties, stock damage, and losses, even for well-conditioned seedlings. Because the moderate Maritime climate is characterized by a mid-winter warm period and erratic snow cover at many locations it is necessary to protect stock from desiccation (windburn) and temperature extremes. Cold frames and overwintering houses (unheated, tightly-sealed greenhouses) are used by some growers, but most nurserymen still rely on snow cover to blanket and protect their crops from damage.

Snow cover protects against two kinds of damage. It prevents desiccation by maintaining 100% relative humidity around the foliage that it covers and prevents warm dry winds from removing water from the shoots while the root mass is frozen and incapable of replenishing lost moisture (Wiest 1982). Protection from frost is afforded because temperature extremes are moderated under the layer of snow, which acts as an insulating blanket by trapping some of the heat from the soil mass below.

Operationally, shade areas or long narrow holding areas cut into the woods, designed to protect overwintered crops, can be used. Windbreaks are valuable in and around such areas to control the distribution and retention of snow or, alternatively, to minimize windspeed over the crop when snow cover is absent. However, for a windbreak to be effective, it must be properly designed and placed, since if improperly used it can have the opposite effect. The basic rules for design and placement are the subject of this note.

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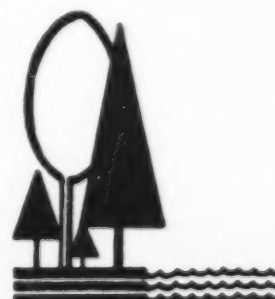
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Canadian Forestry Service - Maritimes
P.O. Box 4000, Fredericton, N.B. E3B 5P7
P.O. Box 667, Truro, N.S. B2N 5E5
P.O. Box 190, Charlottetown, P.E.I. C1A 7K2

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Windbreak Height

Height is an important feature of a windbreak or barrier. All barrier effects, e.g., reduction of windspeed, are measured over distances that are defined in multiples of barrier height. For instance, snow accumulation on the downward side of a windbreak occurs in a zone whose width and distance from the barrier are defined by barrier height. If the zone of maximum accumulation is too narrow, it can be broadened by increasing the barrier height. Because the distance between the barrier and the snow mass will also increase, the barrier may have to be repositioned so that the snow still covers the same area as before, and change in location may conflict with other site requirements. Figures 1-3 portray downwind distance in multiples of height. These diagrams can be used directly to calculate either how tall a barrier should be to give protection at a fixed distance, or conversely, where to position a barrier of fixed height.

If control of blowing snow is required, e.g., to minimize bare patches in a bareroot nursery, it is helpful to know that over 90% of drifting snow moves within a foot of the ground (Darby 1971). Placement of several small barriers may be more effective than a few tall ones.

Another rule-of-thumb is that a windbreak should be at least 20 times longer than it is high and should extend well beyond the crop, or the crop should be partially boxed in (Freeman 1976). Wind curls around the ends of a barrier, thus reducing the zone of effective protection.

Downwind Slope

An overwintering site downhill from a barrier is advantageous, because protection extends over a greater distance than it does for a windbreak of the same height upwind of a level site. The opposite case also holds. An uphill site requires a higher barrier to provide the same amount of protection.

Porosity

The porosity of a windbreak is the ratio of solid material/empty space. Traditional windbreaks consisting of rows of planted trees and shrubs are regarded as "solid" barriers. However, a natural solid barrier actually exhibits considerable porosity. Figure 1 shows that increasing porosity has a dual effect: windspeed is reduced over a greater distance downwind but the magnitude of the greatest reduction is decreased.

Using artificial windbreak materials, porosity can be altered according to the requirements of the site. (Snowfence is normally 50% porous, but would be 75% porous with every second slat removed.) Figure 2 shows that windspeed on the downwind (lee) side of a barrier is reduced, but to differing degrees according to: a) barrier porosity, b) leeside distance, and c) height above the ground surface. One important effect of increasing porosity is that, even though overall windspeed reduction decreases, the reduction becomes more evenly distributed over a longer leeside distance. This may be important where the size or number of windbreak(s) is limited, but conditions must be maintained over a long distance downwind.

Snow Cover

Snow is trapped and retained by a barrier as a function of windspeed, since the greatest snow accumulation occurs in the region where the windspeed is lowest. As porosity increases, snowcover becomes more even over a longer distance downwind (Fig. 3), but the depth of accumulation decreases.

Barrier Materials and Construction

Artificial barriers with slats are preferable to shadecloth, which can clog with blowing snow. Snowfencing is the most commonly used material. It is about 50-60% porous and 1.2 m high. Removing slats and placing more than a one fence-width on shadeframe posts can enhance its flexibility. A new synthetic shading material appears to have considerable potential for overwinter sheltering (Paraweb from I.C.I.). Paraweb is available in heights from 1 m up to 2.2 m, and in porosities of 25, 46, and 65%.

The size and spacing of the supports for tall barriers are important in order to withstand high winds. A windbreak support consisting of timber poles 7.6 m long with 1.5 m buried in the ground, spaced at 6 - 9 m intervals, can withstand windspeeds in excess of 135 km/h (Freeman 1976). Guywires are unnecessary if "bedlogs" are buried just beneath the ground on both the leeward and windward sides of each support pole.

Low vegetation barriers can be used to catch and hold snow in open windy areas. This method may be applicable where the field or holding area is large, or it is too costly to construct an artificial barrier. Rows of a tall grass are sown in the summer at regular intervals and left uncut so that snow will accumulate between them. Greb et al. (1971) have suggested that any grass 46-66 cm high (18-26 in.) planted in double rows (effective density of 65-75% porosity) results in even snow distribution for up to 12 times the barrier height.

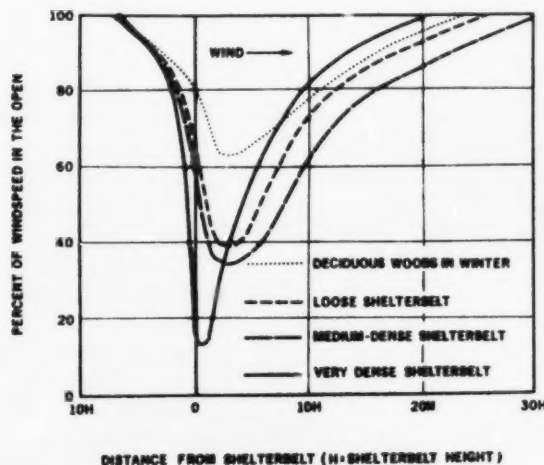


Fig. 1. The effect of shelterbelt porosity and downwind distance on leeward side (Redrawn from Plate (1971) citing Nageli (1941).

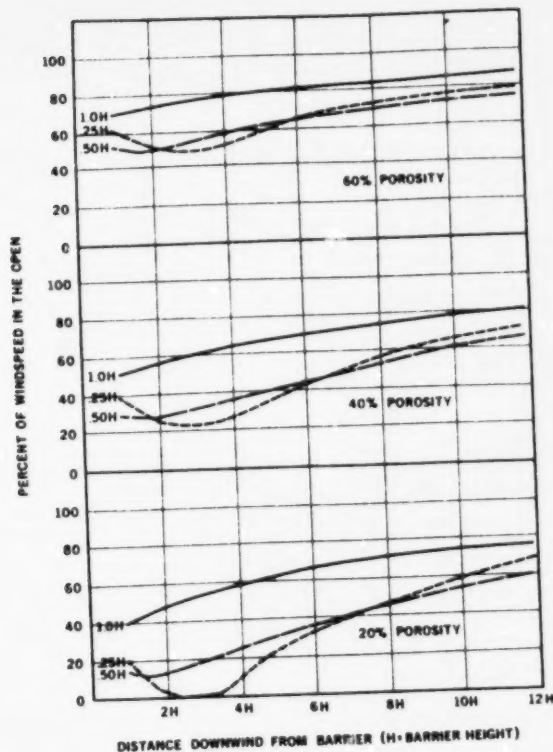


Fig. 2. Reduction of leeside wind-speed by an artificial barrier as a function of porosity and downwind distance. Adapted from Hagen et al. (1980).

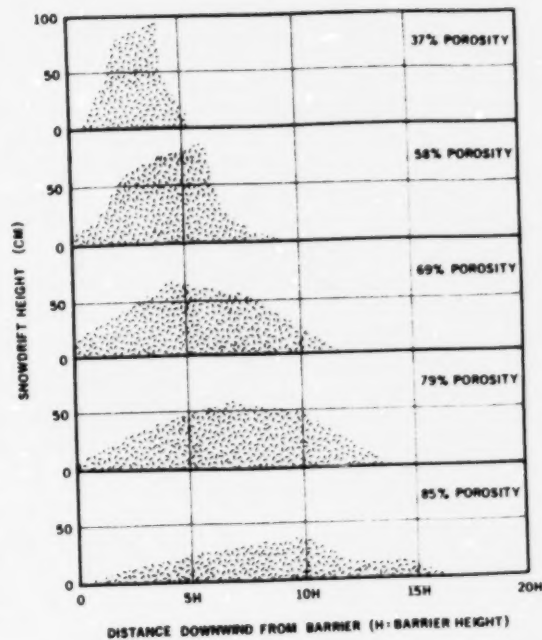


Fig. 3. The effect of barrier porosity on snowdrift height and distribution. Adapted from Greb and Black (1971).

References

- Darby, D.E. 1971. Snow and wind control for farmstead and feedlot. Can. Dep. Agric. Publ. No. 1461. 21 pp.
- Freeman, B. 1976. Artificial windbreaks in horticulture. *Plasticulture* 32: 45-54.
- Greb, B.W., and A.L. Black. 1971. Vegetative barriers and artificial fences for managing snow in the Central and Northern Plains. In: A.O. Haugen (ed.) *Proc. of the Snow and Ice in Relation to Wildlife and Recreation Symposium*. Feb. 11-12, 1971. Iowa Cooperative Wildlife Research Unit, Iowa State Univ., Ames, Iowa. pp. 96-111.
- Hagen, L.J., E.L. Skidmore, P.L. Miller, J.E. Kipp. 1980. Simulation of effect of wind barriers on airflow. ASAE Paper no. 80-2034 19 pp.
- Plate, E.J. 1971. The aerodynamics of shelter belts. *Agric. Meteorol.* 8: 203-222.
- Wiest, S.C. 1982. Transport of xylem water in a thermal gradient: an additional factor involved in the development of winter desiccation injury. In: P.H. Li and A. Sakai (eds.) *Plant Cold Hardiness and Freezing Stress*. vol. 2. Academic Press, Toronto. pp. 511-527.

S.I. Cameron
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